CHARLESTON MARITIME CENTER

BIOREMEDIATION PLAN

PREPARED FOR:

THE CITY OF CHARLESTON
75 Calhoun Street
Charleston, South Carolina 29401

PREPARED BY:

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December 1994

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CHARLESTON MARITIME CENTER
BIOREMEDIATION PLAN

I. GENERAL

The City of Charleston needs to dredge approximately 77,000 CY of slightly contaminated sediments from the Charleston Maritime Center site. Substantial testing has been conducted to quantify the contaminants and this information has been utilized in developing a basin design and a dredging program that will safely protect the environment. However, once the project is completed - the contaminated sediments still remain.

The City has been able to obtain permission to utilize a site on Daniel Island that has been planned as part of a future regional park site. Because of the long range public benefit of the park site, and because the City would also like to have the flexibility to operate the proposed spoil basin unimpeded by limitations of contaminated sediments, the City has proposed a bioremediation/bioreclamation plan to reduce the contaminants to acceptable levels that would ultimately allow dried dredged material reuse.

While initial dredging is for 77,000 CYS, the shoaling rate at the Charleston Maritime Center site is unknown and very unpredictable. Maintenance dredging may be required in as little as eighteen months, or as often as thirty-six months. Therefore, the bioremediation efforts for original dredging must fit in a very short span of time - approximately nine months. Bioremediation of the contaminants of concern (PAH's) is commercially available.

II. SAMPLING AND TESTING FOR CONTAMINANTS

It had originally been proposed that the initial dredging from the Charleston Maritime Center site would be taken to Morris Island and subsequent maintenance dredging would then be taken to ocean disposal. In accordance with DHEC requirements, an elutriate test of sediments to be dredged to Morris Island was conducted and the data turned over to DHEC. Subsequently, after evaluation of the elutriate data, a 401 Water Quality Certification was granted for the disposal at Morris Island. In conjunction with the maintenance dredging ocean disposal activities, a bulk chemistry test was also conducted at the site as the first step in a "tiered approach" to testing. In December 1993, a broad array of tests were performed at the Charleston Maritime Center site for further evaluation of sediments to be dredged to Morris Island. The sampling and testing methodology for this battery of tests was developed with both state and federal agency overview and input. The results of the five boring locations produced two samples from each boring - one composite sample from 0 - 10 feet

and one composite sample from 10 - 20 feet. This gave a total of ten samples from the Charleston Maritime Center site. An off-site background sample near the Mark Clark Expressway over the Wando River was also included. (See Appendix A)

In late November, in conjunction with the Corps of Engineers, the City decided to conduct further evaluation of the sediments and contaminants for the purpose of utilizing the Corps of Engineers' SETTLE and EFQUAL models in designing a dredge material treatment basin to meet suspended sediment and effluent quality criteria. These tests verified the contaminants from previous tests and provided necessary data for the Corps models. (See Appendix B)

III. DESCRIPTION OF CONTAMINANTS

The results of the December 1993 sampling and testing program indicated contaminants of concern to be PAH's (polynuclear aromatic hydrocarbons) with total PAH residues ranging from 10.858 ppm to 44.797 ppm, with an average of 19.03 ppm. There were also some elevated levels of Arsenic and other heavy metals. The results of the November 1994 testing were utilized in the Corps EFQUAL model and PAH's, Acenapthene, Antimony, Arsenic, and Selenium were contaminants of concern for the Corps models.

IV. CONTAMINANT LEVELS

Currently EPA has no established published criteria for contaminated dredged sediment evaluation, so EPA water criteria is used in the EFQUAL model (Tina Hadden - Corps Dredging Specialist). The results from the EFQUAL model indicated that to meet the Marine Water Acute Toxicity Criteria established by EPA, the total concentrations of solids should not exceed 48 mg/L. DHEC monitoring criteria for dredging effluent is 110 mg/L. The design guideline recently set by DHEC for the Charleston District Corps of Engineers is 55 mg/L.

However, in the absence of sediment criteria from EPA, resource agencies are relying on studies conducted in a number of areas throughout the country to attempt to relate chemical contamination to biological effects on marine organisms. Studies conducted by Long and Morgan and subsequently, revised by Long and McDonald, although not originally intended for agency guideline use, have been extrapolated by resource agencies for use in predicting biological effects. Appendix C contains these current criteria for ERM (effects range medium) for various organic components and trace metals.

V. PROPOSED BIOREMEDIATION

The official designation for contaminated material varies from "anything in excess" to definitive numbers such as are represented in the Long and McDonald studies, however, none have been officially adopted by EPA. The first revision of the Charleston Maritime Center permit application included a proposal for bioremediation efforts to reduce the level of contamination by 50%. Recent indications from resource agencies have indicated that if the contaminant levels could be reduced to the ERM levels (Long and McDonald), then they (the agencies) would consider the bioremediation successful and the material no longer contaminated. This would then make the dredged material suitable for other beneficial uses or in construction of berms and dikes.

VI. BIOREMEDIATION IMPLEMENTATION

Current plans by the City of Charleston call for development of "performance criteria" for bioremediation efforts to reduce to acceptable levels (fifty percent total PAH, or ERM criteria). A study was conducted by General Engineering Laboratories into the potential for bioremediation to meet the fifty percent criteria, and substantive responses from responsible firms indicated that bioremediation to 50% of existing levels of PAH's is technically and economically feasible. Bioremediation of other contaminants - trace metals such as Arsenic, Antimony, Selenium - are not conducive to bioremediation of PAH's. In the most recent testing of November 1994 (Appendix B), TCLP of sediments indicates that the PAH components are tightly bound to sediments and if the sediments are controlled in the dredging process and are confined in a CDF, then it is likely that PAH contaminants are also controlled. Similarly - using the Corps EFQUAL and SETTLE model - trace elements are also controlled during the dredging process. Previous TCLP tests for trace elements preliminarily do not indicate a proclivity for further leaching of metals from the CDF. (GEL memo to Guerry Taylor, 12/8/94) Arsenic, a naturally occurring metal, exists throughout Charleston Harbor and has shown up in many surface water and ground water samples. Providing the proposal is economically feasible for the City, the bioremediation program will go forward. (See Item 3 Below).

An outline of the proposed bioremediation plan includes the following:

1. Establishment of bioremediation goals - fifty percent total PAH reduction of PAH levels. At this level of reduction, all agencies should agree that the sediments would no longer be considered contaminated and could be used elsewhere.

2. Development of a bioremediation performance specification and proposal package. This would then be distributed to qualified bidders for pricing.

3. Award the contract and integrate the time schedule with the dredging schedule. If an economically feasible proposal is not found, the City will execute the contingency plan of capping (min - 1ft) with approved dredged material.

4. Dredge the project.

5. Prior to commencement of bioremediation activities , the successful bioremediation contractor would develop the bioremediation program to include the following:

   a. Submission of a Preliminary Contractor Work Plan and Schedule.

   b. Initial testing of the sediments in the basin.

   c. Bench Test for bioremediation process evaluation.

   d. Approval of a Final Contractor Work Plan, Schedule and Bioremediation program which will include at least the following: (1) Testing intervals and reports, (2) Performance Evaluations, (3) Contingency measures to correct non-performing elements, and (4) Time schedule for final completion.

6. Bioremediate the project.

7. Test/evaluate the results.

8. Refine/complete - non conforming elements.

9. The City will develop a final report on the bioremediation which will be forwarded to the Corps of Engineers.

It is expected that bioremediation efforts will be effective within nine months after dredging is completed.

VII. BIOREMEDIATION CONTINGENCY PLANS

While every indication currently exists that bioremediation to non-contaminated levels (fifty percent reduction or ERM levels) will be successful within nine months , the possibility does exist that this may not be the case. In the event that the bioremediation does not work in a timely manner as contracted for, the City intends to place a one foot cap of suitable dredged material on top of the previously dredged sediments. This methodology has been approved in South Carolina and in other sections of the country. Within 60 days after completion of dredging, a sampling and testing program to assess the contaminant levels in the dredge basin will be instituted. If bioremediation is undertaken, the results from bioremediation testing

will be on record; if bioremediation is not undertaken (and capping is) then monthly testing will be conducted for a period of one year or until capping is completed. Either at the end of the bioremediation period or after capping is completed, a report on the results and the current status will be provided to the Corps of Engineers. Only nine months can be allowed for the bioremediation efforts because the shoaling rate at the Charleston Maritime Center site is unpredictable and the potential for maintenance dredging exists within eighteen months after completion of initial dredging.

VIII. SUMMARY

There is widespread interest in the bioremediation efforts on the Charleston Maritime Center site. Step down technology from more serious contamination projects is quickly becoming more commercially available. This factor, combined with the growing need to establish within the dredging industry - and within Charleston Harbor - viable dredging/bioremediation/ bioreclamation alternatives makes the Charleston Maritime Center project a focus for the region and the nation.

APPENDIX A

DECEMBER 1993 TEST RESULTS

Charleston County
P. 0. Box 1082
Mt. Pleasant, SC 29465

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(803) 884-6415
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(803) 884-4026

Jon Guerry Taylor, P.E., Inc.
Engineers, Environmental Planners and Marina Industry Consultants

MEMO TO: Reviewing Agencies

FROM: Guerry Taylor

DATE: January 6, 1994

RE: Charleston Maritime Center
Testing Results
Sediment Testing Plan

Attached please find summaries of the final metals testing. Also attached are revised preliminary tributyltin results for your review. In addition we have had the lab revise the results format to show total PAH's and PAH and tributyltin in parts per million. For your information, I have also included a copy of the map showing the test sites (C1 - C5) in the event someone did not get it previously.

As in the past, please feel free to call on me with any questions that you might have or discussions that we might have relative to the results of these tests and/or actions the City may need to take in conjunction with construction of our project. Thank you for attendance today and your prompt and courteous attention to this matter.

TRIBUTYLTIN in Sediment

Analysis by GC/FPD
Client:Charleston
Lab Project No.: 1293019

Client ID	Sample	TBT ppm	% Recovery	TBT ppm(dry weight)
C1-A	1293019-1	0.069		0.194
C1-B	1293019-2	0.046		0.131
C2-A	1293019-3	0.020		0.063
C2-B	1293019-4	ND(.003)		ND(.008)
C3-A	1293019-5	ND(.003)		ND(.008)
C3-B	1293019-6	ND(.003)		ND(.008)
C4-A	1293019-7	ND(.003)		ND(.008)
C4-B	1293019-8	ND(.003)		ND(.008)
C5-A	1293019-9	ND(.003)		ND(.008)
C5-B	1293019-10	0.040		0.114
C6	1293019-11	ND(.003)		ND(.008)
C6-MS	1293019-11MS	0.17	83	0.24
C6-MSD	1293019-11MSD	0.20	102	0.30
Method Blank	1293019-MB	ND(.003)		ND(.008)

MS/MSD QC limits 50-120%
TBT - Tributyltin
ND(xx) - not detected at the detection limit "xx"
Detection limit calculated as 2.5 times noise

DATA SUMMARY FOR POLYAROMATIC HYDROCARBON ANALYSIS OF SEDIMENT SAMPLES AND ONE WATER SAMPLE
Project #1293019. All sediment samples corrected for residue per dry weight.

Lab I.D.:	1293019-7	1293019-8	1293019-9	1293019-10	1293019-11	1293019-12
Client I.D.:	C4-A	C4-B	C5-A	C5-B	C6	E Rinsate
	ppm	ppm	ppm	ppm	ppm	ppm
Naphthalene	2.477 D	0.510 UD	0.304 JD	0.553 UD	0.024 U	0.000 J
Acenaphthylene	1.145 UD	0.232	0.199	0.377	0.074	0.000 U
Acenaphthene	0.229 JD	0.322 JD	0.329 JD	0.021 JD	0.004 J	0.000 J
Fluorene	0.217 D	0.377 D	0.211 D	0.250 D	0.003 J	0.000 J
Phenanthrene	0.664 D	0.953 D	0.577 D	0.615 D	0.012	0.000 J
Anthracene	1.104 D	0.812 D	0.925 D	1.878 D	0.004	0.000 J
Fluoranthene	2.221 D	2.237 D	5.080 D	4.754 D	0.010	0.000 J
Pyrene	0.945 D	0.982 D	2.325 D	1.878 D	0.004	0.000 J
Benzo(a)anthracene	1.150 D	0.090 D	1.997 D	1.759 D	0.032	0.000
Chrysene	1.536 D	0.903 D	2.296 D	2.314 D	0.010	0.000
Benzo(b)fluoranthene	1.955 D	1.473 D	3.298 D	0.227 D	0.382	0.000
Benzo(k)fluoranthene	0.651 D	0.358 D	0.956 D	0.783 D	0.003	0.000
Benzo(a)pyrene	1.222 D	0.768 D	1.477 D	1.523 D	0.019	0.000
Dibenz(a,h)anthracene	1.623 D	0.725 D	1.476 D	1.691 D	0.027	0.000
Benzo(g,h,i)perylene	1.600 D	1.052 D	1.038 D	1.480 D	0.050	0.000
Indeno[1,23-c,d]pyrene	0.632 D	0.378 D	0.755 D	0.689 D	0.009	0.000
Total Residue (ppm):	19.371	12.173	23.241	20.791	0.667	0.002
Surrogate %Recovery:	45.9 D	48.0	58.8	57.5	116.2	92.1

D – Value calculated from a sample which was diluted 10-fold or more for analysis.
U – Not detected at the indicated MDL.
J – The value is below the lowest calibration point.

DATA SUMMARY FOR POLYAROMATIC HYDROCARBON ANALYSIS OF SEDIMENT SAMPLES AND ONE WATER SAMPLE
Project #1293019. All sediment samples corrected for residue per dry weight.

Lab I.D.:	1293019-1	1293019-2	1293019-3	1293019-4	1293019-5	1293019-6
Client I.D.:	C1-A	C1-B	C2-A	C2-B	C3-A	C3-B
	ppm	ppm	ppm	ppm	ppm	ppm
Naphthalene	0.366 JD	0.543 UD	0.837 D	0.330 JD	0.446 JD	0.345 JD
Acenaphthylene	0.185	0.312	0.901 JD	0.805 UD	0.922 UD	0.192 UD
Acenaphthene	0.049 JD	0.264 JD	0.490 JD	3.293 D	0.048 JD	0.074 JD
Fluorene	0.274 D	0.267 D	0.214 D	0.894 D	0.130 D	0.220 D
Phenanthrene	0.665 D	0.713 D	0.861 D	5.941 D	0.264 D	0.419 D
Anthracene	0.954 D	0.603 D	0.474 D	2.388 D	0.444 D	0.643 D
Fluoranthene	3.636 D	1.700 D	2.715 D	7.508 D	1.568 D	1.711 D
Pyrene	1.561 D	0.858 D	1.424 D	5.092 D	0.756 D	0.848 D
Benzo(a)anthracene	1.581 D	0.720 D	0.788 D	2.513 D	0.849 D	0.656 D
Chrysene	2.293 D	1.099 D	0.850 D	2.790 D	0.867 D	0.789 D
Benzo(b)fluoranthene	2.930 D	1.697 D	1.605 D	3.947 D	1.596 D	1.620 D
Benzo(k)fluoranthene	0.902 D	0.407 D	0.406 D	1.199 D	0.357 D	0.326 D
Benzo(a)pyrene	1.501 D	0.717 D	0.672 D	3.372 D	0.682 D	0.725 D
Dibenz(a,h)anthracene	1.244 D	1.035 D	1.032 D	1.578 D	0.811 D	0.821 D
Benzo(g,h,i)perylene	1.230 D	1.123 D	0.983 D	1.489 D	1.124 D	1.125 D
Indeno[1,23-c,d]pyrene	0.697 D	0.427 D	0.406 D	1.658 D	0.401 D	0.344 D
Total Residue (ppm):	20.069	12.485	14.660	44.797	11.265	10.858
Surrogate %Recovery:	145.9	81.8	66.1 D	78.5 D	46.0 D	447.9

D - Value calculated from a sample which was diluted 10-fold or more for analysis.
U - Not detected at the indicated MDL.
J - The value is below the lowest calibration point.

TRIANGLE LABORATORIES of RTP, INC.
PO BOX 13485
RTP, NC 27709

INORGANICS ANALYSIS REPORT

TLI PROJECT #: 26226
CLIENT: JON GUERRY TAYLOR, P.E., INC.
DATE RECEIVED: 12/17.93
DATE REPORTED: 01/03/93

Results in mg/Kg (dry weight)

CLIENT SAMPLE ID	Ag	As	Ba	Cd	Cr	Cu	Hg	Pb	Se	Zn
C1-A	< 0.85	18.6	21.3	< 0.42	17.6	14.5	< 0.25	26.6	< 2.42	68.0
C1-B	< 0.95	24.3	36.9	< 0.47	32.6	19.4	< 0.14	117	< 2.71	84.6
C2-A	< 1.02	20.9	31.6	< 0.51	24.6	18.0	< 0.23	37.4	< 2.91	83.0
C2-B	< 0.56	22.6	49.5	< 0.28	25.1	34.2	0.44	168	< 1.61	136
C3-A	< 1.00	24.8	24.7	< 0.50	22.1	15.2	< 0.11	32.4	< 2.85	77.9
C3-B	< 0.80	24.2	52.4	< 0.40	46.1	21.3	< 0.22	43.4	< 2.28	99.3
C4-A	< 0.65	28.2	40.8	< 0.32	47.7	20.4	< 0.18	32.2	< 1.84	93.1
C4-B	< 1.04	24.8	28.5	< 0.52	25.0	14.4	< 0.21	27.5	< 2.96	71.6
C5-A	< 0.96	23.5	33.0	< 0.48	25.5	17.4	< 0.17	28.8	< 2.74	85.4
C5-B	< 1.04	27.7	34.3	< 0.52	25.8	16.7	< 0.17	29.6	< 2.97	83.9
C6	< 0.33	6.67	11.6	< 0.17	11.0	< 3.7	< 0.05	5.91	< 0.95	18.3

QC Summary

CLIENT SAMPLE ID	Ag	As	Ba	Cd	Cr	Cu	Hg	Pb	Se	Zn
C1-A D %RPD	<IDL	7.6%	25.7%	<IDL	3.2%	<IDL	N/A*	11.6%	<IDL	3.1%
C1-B D %RPD	<IDL	11.0%	5.1%	<IDL	9.2%	<IDL	N/A*	98%	<IDL	3.5%
C2-A L %RPD	N/A	N/A	<IDL	N/A	N/A	<IDL	N/A	N/A	N/A	<IDL
C3-B L %RPD	N/A	N/A	<IDL	N/A	N/A	<IDL	N/A	N/A	N/A	<IDL
C2-B S %REC	114%	115%	94.0%	18.4%	77.0%	92.2%	69.7%	NV	90.1%	89.1%
C5-B SD %REC	110%	93.7%	103%	17.1%	98.3%	94.2%	81.6%	NV	80.9%	92.2%
C3-A S %REC	110%	82.4%	93.2%	17.7%	44.9%	90.8%	61.6%	103%	95.6%	84.1%
C3-A SD %REC	116%	85.5%	93.9%	17.3%	73.9%	90.9%	39.4%	121%	93.5%	85.2%
PBW ug/L	<2.0	<4.3	<5.1	<1.0	<5.2	<22	N/A*	<3.7	<5.7	<6.4
LCS %REC	105%	92.6%	96.4%	20.2%	60.5%	94.8%	N/A*	102%	135%	94.0%
LCS D %REC	111%	92.4%	95.0%	22.1%	63.9%	95.2%	N/A*	101%	139%	94.7%

*See Hg analyte summary sheet for QC data

TRIANGLE LABORATORIES of RTP, INC.
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RTP, NC 27709

INORGANICS ANALYSIS REPORT

TLI PROJECT #: 26154
CLIENT: JON GUERRY TAYLOR, P.E., INC.
DATE RECEIVED: 12/13/93
DATE REPORTED: 01/03/94

Results in mg/L

CLIENT SAMPLE ID	Ag	As	Ba	Cd	Cr	Cu	Hg	Pb	Se	Zn
DECON RINSATE	< 0.004	< 0.010	< 0.011	< 0.002	< 0.012	< 0.049	< 0.005	< 0.008	< 0.006	< 0.014

QC Summary

CLIENT SAMPLE ID	Ag	As	Ba	Cd	Cr	Cu	Hg	Pb	Se	Zn
DECON RINSATE D %RPD	<IDL	<IDL	<IDL	<IDL	<IDL	<IDL	<IDL	<IDL	<IDL	<IDL
DECON RINSATE L %RPD	N/A	N/A	<IDL	N/A	N/A	<IDL	N/A	N/A	N/A	<IDL
DECON RINSATE S %REC	103%	92.2%	98.1%	17.5%	90.7%	101%	78.5%	94.8%	101%	98.0%
DECON RINSATE SD %REC	103%	90.0%	99.0%	18.0%	92.8%	97.7%	77.9%	97.3%	94.8%	103%
PBW ug/L	<2.0	<4.3	<5.1	<1.0	<5.2	<22	N/A*	<3.7	<2.6	<6.4
LCS %REC	102%	92.9%	98.1%	16.2%	104%	97.4%	N/A*	100%	102%	100%
LCS D %REC	106%	94.6%	98.6%	19.8%	99.3%	101%	N/A*	94.5%	95.2%	95.8%

*See Hg analyte summary sheet for QC data

INORGANICS ANALYSIS REPORT
PAGE 2 OF 2

TLI PROJECT #: 26226 TCLP

QC SUMMARY

CLIENT SAMPLE ID	Ag	As	Ba	Cd	Cr
C5-A D %RPD	<IDL	<IDL	3.6%	<IDL	
C5-B L %RPD	<IDL	<IDL	<IDL	<IDL	
C2-B S %REC	106%	110%	104%	102%	
C2-B SD %REC	95.6%	98.9%	95.6%	93.1%	
TCLP Fluid #1 mg/L	< 0.011	< 0.127	< 0.011	< 0.009	
TCLP Fluid #2 mg/L	< 0.011	< 0.127	< 0.011	< 0.009	
74-79-MB ug/L	< 4.9	< 57	< 5.1	< 4	
74-79-LCS %REC	103%	105%	99.2%	98.9%	
74-79-LCS D %REC	102%	102%	97.4%	96.9%	

1/5/94 Due

CLIENT SAMPLE ID	Cu	Pb	Se	Zn	Hg
C5-A D %RPD	<IDL	<IDL	<IDL	1.3%	N/A*
C5-B L %RPD	<IDL	<IDL	<IDL	<IDL	N/A*
C2-B S %REC	105%	100%	127%	103%	96%
C2-B SD %REC	95.2%	91.0%	112%	93.4%	142%
TCLP Fluid #1 mg/L	< 0.049	< 0.133	< 0.200	0.024	< 0.0005
TCLP Fluid #2 mg/L	< 0.049	< 0.133	< 0.200	0.022	< 0.0005
74-79-MB ug/L	< 22	< 60	< 90	< 6.4	N/A*
74-79-LCS %REC	100%	98.0%	117%	97.3%	N/A*
74-79-LCS D %REC	98.3%	97.4%	114%	95.5%	N/A*

See Mercury (Hg) summary sheet for QC data

PRELIMINARY RESULTS
Final QC Not Yet Performed
Released at Client Request

TRIANGLE LABORATORIES of RTP, INC.
PO BOX 13485
RTP, NC 27709

INORGANICS ANALYSIS REPORT

TLI PROJECT #: 26226 TCLP
CLIENT: JON GUERRY TAYLOR, P.E., INC.
DATE RECEIVED: 12/17/93
DATE REPORTED: 01/04/93

TCLP

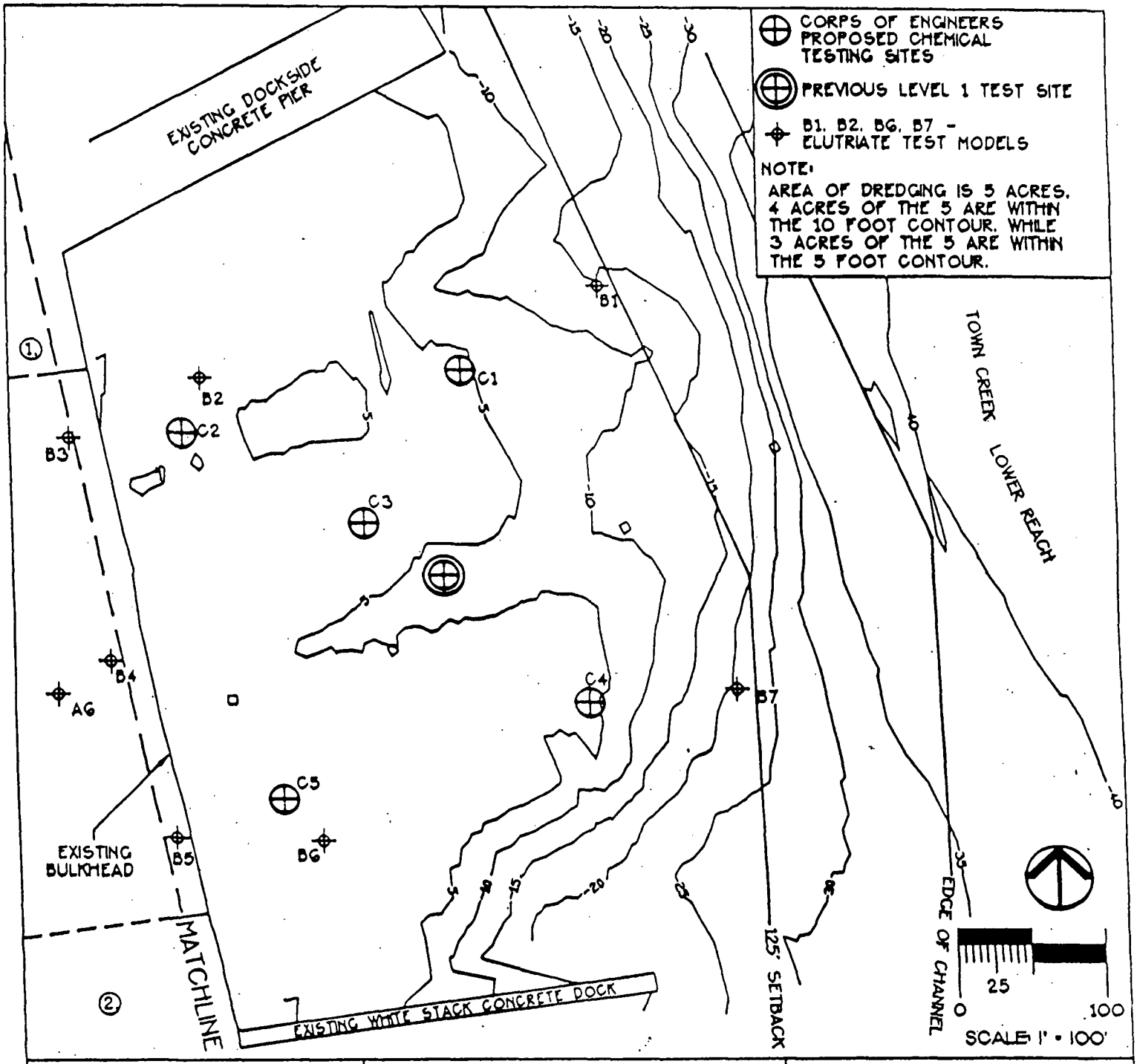
Results in mg/L

CLIENT SAMPLE ID	Ag	As	Ba	Cd	Cr
C2-A	< 0.011	< 0.127	0.037	< 0.009	
C2-B	< 0.011	< 0.127	0.139	< 0.009	
C5-A	< 0.011	< 0.127	0.047	< 0.009	
C5-B	< 0.011	< 0.127	0.088	< 0.009	
Federal Regulation Limits	5.00	5.00	100	1.00	5.00

Due 1/5/94

CLIENT SAMPLE ID	Cu	Pb	Se	Zn	Hg
C2-A	< 0.049	< 0.133	< 0.200	< 0.014	< 0.0005
C2-B	< 0.049	< 0.133	< 0.200	0.037	< 0.0005
C5-A	< 0.049	< 0.133	< 0.200	0.347	< 0.0005
C5-B	< 0.049	< 0.133	< 0.200	0.037	< 0.0005
Federal Regulation Limits	N/A	5.00	1.00	N/A	0.200

PRELIMINARY RESULTS
Final QC Not Yet Performed
Released at Client Request



ADJACENT PROPERTY OWNERS:
① DOCKSIDE CONDOMINIUMS
② WHITE STACK TOWING INC

DATUM: MLW

EXISTING SITE (WATERSIDE)

CHARLESTON MARITIME CENTER

CITY OF CHARLESTON
116 MEETING STREET
CHARLESTON, SC 29401

PROPOSED: DREDGING, BULKHEAD, AND MARINA

IN: CHARLESTON
ON: COOPER RIVER
COUNTY OF: CHARLESTON
STATE OF: SC
SHEET: 1 OF 1 DATE: 5/3/93
REVISED: 10/22/93

JON GUERRY TAYLOR P.E.
MCP3BORE

APPENDIX B

NOVEMBER 1994 TEST RESULTS

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

December 2, 1994

Mr. Jon Guerry Taylor, P.E.
Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mount Pleasant, South Carolina 29465

Re: Analytical Results
Dredging Permit Application
Charleston Maritime Center

Dear Guerry:

Enclosed are the results of the analyses for the Charleston Maritime Center project. Data from these analyses will be used to design a confined disposal facility (CDF) for the proposed dredge material and evaluate the effluent water quality from the proposed CDF. Although portions of the analytical results have been forwarded to you previously, this letter contains a brief description of the results as well as the Certificates of Analyses for all of the analyses.

Sediment from the Charleston Maritime Center site was collected from two locations at the proposed dredge site by Athena Technologies, Inc.. The sample locations were documented by Jon Guerry Taylor, Inc. personnel. Sediment collected from the two locations was composited into one homogenous sample and analyzed for the following:

- Modified Elutriate Test - Total Concentrations
- Modified Elutriate Test - Dissolved Concentrations
- Background Surface Water Sample
- Column Settling Test (CST)

In addition, sediment samples from each location were analyzed for the following parameters:

- Specific Gravity
- Moisture Content
- Polynuclear Aromatic Hydrocarbons (PAHs) using Toxicity Characteristic Leaching Procedure Extraction Method (TCLP)
- PAHs - Total Concentrations

The results of these analyses are summarized below.

The two modified elutriate tests and the background surface water sample were analyzed for total suspended solids and for the Environmental Protection Agency's list of Priority Pollutants except for the volatile organic compounds. Constituents of concern detected in these samples are presented in the attached table. Constituents of concern are primarily limited to PAHs and metals.

Results of the CST are also attached. A separate table is included for the zone settling data for a 24 hour period following mixing.

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Specific gravity and moisture content analyses were also necessary to provide data for the United States Army Corps of Engineers computer model used to design the proposed CDF. The specific gravity tests were performed using the American Society of Testing and Materials Method D 5057 and is based on the analysis of bulk sediment prior to drying. Moisture content was determined by evaporative loss. Results of these analyses are presented below in Table 1.

Table 1
Results of Specific Gravity and
Moisture Content Analyses

Sample I.D.	Specific Gravity	Moisture Content
9411385-01	1.28	63.0%
9411385-02	1.31	63.0%

Samples TCLP-1 and TCLP-2 were collected and analyzed for PAHs by TCLP to provide an indication of the amount of PAHs the sediments to be dredged would potentially leach to soils and/or groundwater underlying the CDF. Samples PAH-1 and PAH-2 were analyzed for total concentrations of PAHs so that a comparison can be made with the amount leached. The results of these analyses are summarized in Table 2.

Table 2
Results PAH Analyses

Constituent	PAH-1	PAH-2	TCLP-1	TCLP-2
Acenaphthene	3830	ND	28	0.83J
Anthracene	3190	ND	2.21J	0.48J
Benzo(b) flouranthene	3930	ND	ND	ND
Benzo(k) flouranthene	ND	1479	ND	ND
Chrysene	2040	ND	ND	ND
Flouranthene	7110	1800	2.35J	ND
Flourene	ND	ND	8.11J	ND
Naphthalene	828J	ND	1.25J	ND
Phenanthrene	6940	ND	7.00J	ND
Pyrene	ND	ND	1.91J	ND

All concentrations are in parts per billion
ND: not-detected
J: estimated concentration

As indicated in Table 2, most of the PAHs identified in the sediment to be dredged would remain bound to the sediment in the CDF and not leach to the environment.

If I can answer any questions or provide you with additional information regarding this report, please contact me at (803) 769-7378, extension 4447. On behalf of General Engineering Laboratories, Inc., I would like to thank you for the opportunity to assist you in meeting your environmental needs.

Yours very truly,

J. Edward Buxton
Environmental Scientist

enclosures

fc: jgti00494.113094

GENERAL ENGINEERING LABORATORIES
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Analytical Results Table
Modified Elutriate and Background
Surface Water Samples
Charleston Maritime Center

Constituents of Concern	Modified Elutriate (total)	Modified Elutriate (dissolved)	Background Surface Water
Acenaphthene	10.6	9.82J	U
Acenaphthylene	0.16J	0.17J	U
Anthracene	1.00J	0.67J	U
Di-n-butyl phthalate	0.54J	0.58J	U
Endrin aldehyde	U	U	95.0
Flouranthene	1.39J	U	U
Naphthalene	1.73J	2.21J	U
Phenanthrene	2.33J	1.36J	U
Pyrene	1.46J	U	U
bis(2-Ethylhxyl)phthalate	11.9	2.50J	U
Antimony	33.5	20.2J	U
Arsenic	35.9	12.1J	2.30J
Beryllium	0.05J	0.13J	0.10J
Cadmium	1.53J	0.17J	U
Chromium	0.92J	2.63J	U
Copper	0.70J	U	3.10J
Nickel	U	3.40J	5.30J
Lead	1.50J	6.90J	0.310J
Selenium	22.6	18.70J	U
Thallium	0.54J	U	U
Zinc	3.36J	20.1	U
Mercury	0.217J	0.159J	U
Cyanide	2.37J	0.95J	0.47J
Total Phenols	0.69J	0.69J	0.69J
Total Suspended Solids	25.0	NA	9.0

All concentrations are in ug/l except for total suspended solids which is in mg/l
J: estimated value
U: below method detection limit
NA: Not Analyzed

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Laboratory Certifications	
FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410555-01 Client ID: Matrix: Elutriate Description: Elutriate -Total
Sampled: 10/31/94 Received: 10/31/94 Page: 1
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: GC/MS Extractables Method: EPA 8270					Batch: 56501 Run Analyst: JCB DOA: 11/07/94 TOA: 1437 OK						
					Prep Analyst: JKP DOP: 11/03/94 TOP: 1210 OK						
2,4,6-Trichlorophenol	0.00	U	10.0	ug/l	2.3	ug/l	1:1		0.00		
2,4-Dichlorophenol	0.00	U	10.0	ug/l	1.12	ug/l	1:1		0.00		
2,4-Dimethylphenol	0.00	U	10.0	ug/l	3.6	ug/l	1:1		0.00		
2,4-Dinitrophenol	0.00	U	45.0	ug/l	8.88	ug/l	1:1		0.00		
2-Chlorophenol	0.00	U	10.0	ug/l	1.06	ug/l	1:1		0.00	0.00%	8.04%
2-Nitrophenol	0.00	U	10.0	ug/l	1.14	ug/l	1:1		0.00		
2-methyl-4,6-dinitrophenol	0.00	U	50.0	ug/l	1.78	ug/l	1:1		0.00		
4-Nitrophenol	0.00	U	20.0	ug/l	2.97	ug/l	1:1		0.00		
4-chloro-3-methyl phenol	0.00	U	10.0	ug/l	1.32	ug/l	1:1		0.00	0.00%	8.95%
Pentachlorophenol	0.00	U	10.0	ug/l	1.6	ug/l	1:1		0.00	0.00%	13.0%
Phenol	0.00	U	10.0	ug/l	0.46	ug/l	1:1		0.00	0.00%	6.37%
BG: GC/MS Extractables Method: EPA 8270					Batch: 56501 Run Analyst: JCB DOA: 11/07/94 TOA: 1437 OK						
					Prep Analyst: JKP DOP: 11/03/94 TOP: 1210 OK						
1,2,4-Trichlorobenzene	0.00	U	10.0	ug/l	1.57	ug/l	1:1		0.00	0.00%	9.85%
1,2-Diphenylhydrazine	0.00	U	10.0	ug/l	1.13	ug/l	1:1		0.00		
2,4-Dinitrotoluene	0.00	U	10.0	ug/l	2.02	ug/l	1:1		0.00	0.00%	10.9%
2,6-Dinitrotoluene	0.00	U	10.0	ug/l	1.59	ug/l	1:1		0.00		
2-Chloronaphthalene	0.00	U	10.0	ug/l	1.6	ug/l	1:1		0.00		
3,3'-Dichlorobenzidine	0.00	U	50.0	ug/l	2.51	ug/l	1:1		0.00		
4,4'-DDD	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4,4'-DDE	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4,4'-DDT	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4-Bromophenyl phenyl ether	0.00	U	10.0	ug/l	0.72	ug/l	1:1		0.00		
4-Chlorophenyl phenyl ether	0.00	U	10.0	ug/l	1.98	ug/l	1:1		0.00		
Acenaphthene	10.6		10.0	ug/l	1.57	ug/l	1:1		0.00	0.00%	11.4%
Acenaphthylene	0.160	J	10.0	ug/l	1.68	ug/l	1:1		0.00		
Aldrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Anthracene	1.00	J	10.0	ug/l	1.71	ug/l	1:1		0.00		
Benzidine	0.00	U	50.0	ug/l	16.2	ug/l	1:1		0.00		
Benzo(a)anthracene	0.00	U	10.0	ug/l	2.15	ug/l	1:1		0.00		
Benzo(a)pyrene	0.00	U	10.0	ug/l	1.42	ug/l	1:1		0.00		
Benzo(b)fluoranthene	0.00	U	10.0	ug/l	1.4	ug/l	1:1		0.00		
Benzo(ghi)perylene	0.00	U	10.0	ug/l	1.27	ug/l	1:1		0.00		
Benzo(k)fluoranthene	0.00	U	10.0	ug/l	0.87	ug/l	1:1		0.00		
Butyl benzyl phthalate	0.00	U	10.0	ug/l	1.84	ug/l	1:1		0.00		

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications

FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410555-01 Client ID: Matrix: Elutriate Description: Elutriate -Total
Sampled: 10/31/94 Received: 10/31/94 Page: 2

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
Chlordane	0.00	U	10.0	ug/l	0.01	ug/l	1:1		0.00		
Chrysene	0.00	U	10.0	ug/l	0.95	ug/l	1:1		0.00		
Di-n-butyl phthalate	0.540	J	10.0	ug/l	1.09	ug/l	1:1		0.270		
Di-n-octyl phthalate	0.00	U	10.0	ug/l	2.24	ug/l	1:1		0.00		
Dibenzo(a,h)anthracene	0.00	U	10.0	ug/l	1.19	ug/l	1:1		0.00		
Dieldrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Diethyl phthalate	0.00	U	10.0	ug/l	1.42	ug/l	1:1		0.00		
Dimethyl phthalate	0.00	U	10.0	ug/l	1.65	ug/l	1:1		0.00		
Endosulfan I	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endosulfan II	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endosulfan sulfate	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endrin aldehyde	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Fluoranthene	1.39	J	10.0	ug/l	1.02	ug/l	1:1		0.00		
Fluorene	0.00	U	10.0	ug/l	1.91	ug/l	1:1		0.00		
Heptachlor	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Heptachlor epoxide	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Hexachlorobenzene	0.00	U	10.0	ug/l	1.33	ug/l	1:1		0.00		
Hexachlorobutadiene	0.00	U	10.0	ug/l	2.04	ug/l	1:1		0.00		
Hexachlorocyclopentadiene	0.00	U	10.0	ug/l	1.69	ug/l	1:1		0.00		
Hexachloroethane	0.00	U	10.0	ug/l	1.68	ug/l	1:1		0.00		
Indeno(1,2,3-c,d)pyrene	0.00	U	10.0	ug/l	0.89	ug/l	1:1		0.00		
Isophorone	0.00	U	10.0	ug/l	1.37	ug/l	1:1		0.00		
N-Nitrosodimethylamine	0.00	U	10.0	ug/l	0.77	ug/l	1:1		0.00		
N-Nitrosodiphenylamine	0.00	U	10.0	ug/l	1.32	ug/l	1:1		0.00		
N-Nitrosodipropylamine	0.00	U	10.0	ug/l	1.41	ug/l	1:1		0.00	0.00%	8.71
Naphthalene	1.73	J	10.0	ug/l	1.78	ug/l	1:1		0.00		
Nitrobenzene	0.00	U	10.0	ug/l	1.61	ug/l	1:1		0.00		
PCB-1016	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1221	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1232	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1242	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1248	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1254	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1260	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
Phenanthrene	2.33	J	10.0	ug/l	1.72	ug/l	1:1		0.00		
Pyrene	1.46	J	10.0	ug/l	1.17	ug/l	1:1		0.00	0.00%	10.4
Toxaphene	0.00	U	10.0	ug/l	0.01	ug/l	1:1		0.00		
alpha-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		

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Laboratory Certifications	
FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410555-01 Client ID: Matrix: Elutriate Description: Elutriate -Total
Sampled: 10/31/94 Received: 10/31/94 Page: 3

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
beta-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
bis(2-Chloroethoxy)methane	0.00	U	10.0	ug/l	1.4	ug/l	1:1		0.00		
bis(2-Chloroethyl) ether	0.00	U	10.0	ug/l	1.39	ug/l	1:1		0.00		
bis(2-Chloroisopropyl)ether	0.00	U	10.0	ug/l	1.91	ug/l	1:1		0.00		
bis(2-Ethylhexyl)phthalate	11.9		10.0	ug/l	1.61	ug/l	1:1		0.00		
delta-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
gamma-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
BG: Graphite Furnace Method: EPA 7060					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1735 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Arsenic	35.9		20.0	ug/l	20	ug/l	1:10		0.0700	-1.14%	92.5%
BG: Graphite Furnace Method: EPA 7421					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1735 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Lead	1.50	J	20.0	ug/l	20	ug/l	1:10		0.210	-1.07%	103%
BG: Graphite Furnace Method: EPA 7041					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1735 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Antimony	33.5		30.0	ug/l	30	ug/l	1:10		1.27	1.76%	74.5%
BG: Graphite Furnace Method: EPA 7740					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1735 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Selenium	22.6		20.0	ug/l	20	ug/l	1:10		-0.360	1.13%	75.9%
BG: Graphite Furnace Method: EPA 7841					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1735 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Thallium	0.540	J	5.00	ug/l	2	ug/l	1:1		0.490	-1.65%	101%
BG: ICP Method: EPA 6010					Batch: 56461 Run Analyst: JSS DOA: 11/03/94 TOA: 1147 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Silver	-0.0108	U	0.0300	mg/l	0.005	mg/l	1:1		-0.00577	-0.831%	85.8%
Beryllium	0.0000500	J	0.0100	mg/l	0.0002	mg/l	1:1		0.00	-0.217%	85.8%
Cadmium	0.00153	J	0.00500	mg/l	0.0026	mg/l	1:1		-0.000510	-0.288%	76.9%
Chromium	0.000920	J	0.0300	mg/l	0.0081	mg/l	1:1		0.00727	-0.992%	84.7%
Copper	0.000700	J	0.0300	mg/l	0.0058	mg/l	1:1		0.00388	-1.33%	86.8%
Nickel	-0.000640	U	0.0300	mg/l	0.005	mg/l	1:1		-0.00318	-0.268%	78.9%
Zinc	0.00336	J	0.0200	mg/l	0.005	mg/l	1:1		0.00163	2.08%	80.4%
BG: Mercury Method: EPA 7470					Batch: 56701 Run Analyst: ADF DOA: 11/08/94 TOA: 1340 OK						

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications	
FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410555-01 Client ID: Matrix: Elutriate Description: Elutriate -Total
Sampled: 10/31/94 Received: 10/31/94 Page: 4

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
							Prep Analyst: ADF DOP: 11/07/94 TOP: 1700 OK				
Mercury	0.217	J	0.500	ug/l	0.2	ug/l	1:1		0.0320	1.90%	99.3%
BG: Cyanide by RFA Method: EPA 335.3						Batch: 56559 Run Analyst: JEN DOA: 11/03/94 TOA: 1500 OK					
Cyanide, Total	0.00237	J	0.0100	mg/l	0.01	mg/l	1:1		0.000950	0.00%	91.2%
BG: RFA Method: EPA 420.2						Batch: 56350 Run Analyst: JEN DOA: 11/01/94 TOA: 1400 OK					
Phenols, Total	0.690	J	10.0	ug/l	5	ug/l	1:1		0.690	0.00%	111%
BG: Solids Analyses Method: EPA 160.2						Batch: 57027 Run Analyst: MAS DOA: 11/11/94 TOA: 0930 NOT OK					
Solids, Total Suspended	25.0		1.00	mg/l	1	mg/l	1:1		0.00	0.00%	N/C

Comments:
A dilution was required for Lead due to matrix interference.
As a result, the detection limit is elevated.

This sample was analyzed beyond recommended holding for time
Solids, Total Suspended.

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

GENERAL ENGINEERING LABORATORIES

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SC	10120
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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410555-01 Client ID: Matrix: Elutriate Description: Elutriate -Total
Sampled: 10/31/94 Received: 10/31/94 Page: 5
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Tom Hutto at (803) 556-8171.

Kendra Middleton

Analytical Report Specialist

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications	
FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/10/94

Sample: 9410555-02 Client ID: Matrix: Elutriate Description: Elutriate-Dissolved
Sampled: 10/31/94 Received: 10/31/94 Page: 1

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: GC/MS Extractables Method: EPA 8270					Batch: 56501 Run Analyst: JCB DOA: 11/07/94 TOA: 1509 OK						
					Prep Analyst: JKP DOP: 11/03/94 TOP: 1210 OK						
2,4,6-Trichlorophenol	0.00	U	10.0	ug/l	2.3	ug/l	1:1		0.00		
2,4-Dichlorophenol	0.00	U	10.0	ug/l	1.12	ug/l	1:1		0.00		
2,4-Dimethylphenol	0.00	U	10.0	ug/l	3.6	ug/l	1:1		0.00		
2,4-Dinitrophenol	0.00	U	45.0	ug/l	8.88	ug/l	1:1		0.00		
2-Chlorophenol	0.00	U	10.0	ug/l	1.06	ug/l	1:1		0.00	0.00%	8.04%
2-Nitrophenol	0.00	U	10.0	ug/l	1.14	ug/l	1:1		0.00		
2-methyl-4,6-dinitrophenol	0.00	U	50.0	ug/l	1.78	ug/l	1:1		0.00		
4-Nitrophenol	0.00	U	20.0	ug/l	2.97	ug/l	1:1		0.00		
4-chloro-3-methyl phenol	0.00	U	10.0	ug/l	1.32	ug/l	1:1		0.00	0.00%	8.95%
Pentachlorophenol	0.00	U	10.0	ug/l	1.6	ug/l	1:1		0.00	0.00%	13.0%
Phenol	0.00	U	10.0	ug/l	0.46	ug/l	1:1		0.00	0.00%	6.37%
BG: GC/MS Extractables Method: EPA 8270					Batch: 56501 Run Analyst: JCB DOA: 11/07/94 TOA: 1509 OK						
					Prep Analyst: JKP DOP: 11/03/94 TOP: 1210 OK						
1,2,4-Trichlorobenzene	0.00	U	10.0	ug/l	1.57	ug/l	1:1		0.00	0.00%	9.85%
1,2-Diphenylhydrazine	0.00	U	10.0	ug/l	1.13	ug/l	1:1		0.00		
2,4-Dinitrotoluene	0.00	U	10.0	ug/l	2.02	ug/l	1:1		0.00	0.00%	10.9%
2,6-Dinitrotoluene	0.00	U	10.0	ug/l	1.59	ug/l	1:1		0.00		
2-Chloronaphthalene	0.00	U	10.0	ug/l	1.6	ug/l	1:1		0.00		
3,3'-Dichlorobenzidine	0.00	U	50.0	ug/l	2.51	ug/l	1:1		0.00		
4,4'-DDD	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4,4'-DDE	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4,4'-DDT	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4-Bromophenyl phenyl ether	0.00	U	10.0	ug/l	0.72	ug/l	1:1		0.00		
4-Chlorophenyl phenyl ether	0.00	U	10.0	ug/l	1.98	ug/l	1:1		0.00		
Acenaphthene	9.82	J	10.0	ug/l	1.57	ug/l	1:1		0.00	0.00%	11.4%
Acenaphthylene	0.170	J	10.0	ug/l	1.68	ug/l	1:1		0.00		
Aldrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Anthracene	0.670	J	10.0	ug/l	1.71	ug/l	1:1		0.00		
Benzidine	0.00	U	50.0	ug/l	16.2	ug/l	1:1		0.00		
Benzo(a)anthracene	0.00	U	10.0	ug/l	2.15	ug/l	1:1		0.00		
Benzo(a)pyrene	0.00	U	10.0	ug/l	1.42	ug/l	1:1		0.00		
Benzo(b)fluoranthene	0.00	U	10.0	ug/l	1.4	ug/l	1:1		0.00		
Benzo(ghi)perylene	0.00	U	10.0	ug/l	1.27	ug/l	1:1		0.00		
Benzo(k)fluoranthene	0.00	U	10.0	ug/l	0.87	ug/l	1:1		0.00		
Butyl benzyl phthalate	0.00	U	10.0	ug/l	1.84	ug/l	1:1		0.00		

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications

FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/10/94

Sample: 9410555-02 Client ID: Matrix: Elutriate Description: Elutriate-Dissolved
Sampled: 10/31/94 Received: 10/31/94 Page: 2

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
Chlordane	0.00	U	10.0	ug/l	0.01	ug/l	1:1		0.00		
Chrysene	0.00	U	10.0	ug/l	0.95	ug/l	1:1		0.00		
Di-n-butyl phthalate	0.580	J	10.0	ug/l	1.09	ug/l	1:1		0.270		
Di-n-octyl phthalate	0.00	U	10.0	ug/l	2.24	ug/l	1:1		0.00		
Dibenzo(a,h)anthracene	0.00	U	10.0	ug/l	1.19	ug/l	1:1		0.00		
Dieldrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Diethyl phthalate	0.00	U	10.0	ug/l	1.42	ug/l	1:1		0.00		
Dimethyl phthalate	0.00	U	10.0	ug/l	1.65	ug/l	1:1		0.00		
Endosulfan I	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endosulfan II	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endosulfan sulfate	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endrin aldehyde	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Fluoranthene	0.00	U	10.0	ug/l	1.02	ug/l	1:1		0.00		
Fluorene	0.00	U	10.0	ug/l	1.91	ug/l	1:1		0.00		
Heptachlor	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Heptachlor epoxide	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Hexachlorobenzene	0.00	U	10.0	ug/l	1.33	ug/l	1:1		0.00		
Hexachlorobutadiene	0.00	U	10.0	ug/l	2.04	ug/l	1:1		0.00		
Hexachlorocyclopentadiene	0.00	U	10.0	ug/l	1.69	ug/l	1:1		0.00		
Hexachloroethane	0.00	U	10.0	ug/l	1.68	ug/l	1:1		0.00		
Indeno(1,2,3-c,d)pyrene	0.00	U	10.0	ug/l	0.89	ug/l	1:1		0.00		
Isophorone	0.00	U	10.0	ug/l	1.37	ug/l	1:1		0.00		
N-Nitrosodimethylamine	0.00	U	10.0	ug/l	0.77	ug/l	1:1		0.00		
N-Nitrosodiphenylamine	0.00	U	10.0	ug/l	1.32	ug/l	1:1		0.00		
N-Nitrosodipropylamine	0.00	U	10.0	ug/l	1.41	ug/l	1:1		0.00	0.00%	8.71
Naphthalene	2.21	J	10.0	ug/l	1.78	ug/l	1:1		0.00		
Nitrobenzene	0.00	U	10.0	ug/l	1.61	ug/l	1:1		0.00		
PCB-1016	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1221	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1232	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1242	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1248	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1254	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1260	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
Phenanthrene	1.36	J	10.0	ug/l	1.72	ug/l	1:1		0.00		
Pyrene	0.00	U	10.0	ug/l	1.17	ug/l	1:1		0.00	0.00%	10.4
Toxaphene	0.00	U	10.0	ug/l	0.01	ug/l	1:1		0.00		
alpha-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		

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Laboratory Certifications

FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/10/94

Sample: 9410555-02 Client ID: Matrix: Elutriate Description: Elutriate-Dissolved
Sampled: 10/31/94 Received: 10/31/94 Page: 3
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
beta-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
bis(2-Chloroethoxy)methane	0.00	U	10.0	ug/l	1.4	ug/l	1:1		0.00		
bis(2-Chloroethyl) ether	0.00	U	10.0	ug/l	1.39	ug/l	1:1		0.00		
bis(2-Chloroisopropyl)ether	0.00	U	10.0	ug/l	1.91	ug/l	1:1		0.00		
bis(2-Ethylhexyl)phthalate	2.50	J	10.0	ug/l	1.61	ug/l	1:1		0.00		
delta-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
gamma-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
BG: Graphite Furnace Method: EPA 7060					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1721 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Arsenic	12.1	J	20.0	ug/l	20	ug/l	1:10		0.0700	-1.14%	92.5%
BG: Graphite Furnace Method: EPA 7421					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1721 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Lead	6.90	J	20.0	ug/l	20	ug/l	1:10		0.210	-1.07%	103%
BG: Graphite Furnace Method: EPA 7041					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1721 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Antimony	20.2	J	30.0	ug/l	30	ug/l	1:10		1.27	1.76%	74.5%
BG: Graphite Furnace Method: EPA 7740					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1721 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Selenium	18.7	J	20.0	ug/l	20	ug/l	1:10		-0.360	1.13%	75.9%
BG: Graphite Furnace Method: EPA 7841					Batch: 56457 Run Analyst: RMJ DOA: 11/07/94 TOA: 1721 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Thallium	-0.530	U	5.00	ug/l	2	ug/l	1:1		0.490	-1.65%	101%
BG: ICP Method: EPA 6010					Batch: 56461 Run Analyst: JSS DOA: 11/03/94 TOA: 1148 OK						
					Prep Analyst: FGD DOP: 11/02/94 TOP: 1430 OK						
Silver	-0.00987	U	0.0300	mg/l	0.005	mg/l	1:1		-0.00577	-0.831%	85.8%
Beryllium	0.000130	J	0.0100	mg/l	0.0002	mg/l	1:1		0.00	-0.217%	85.8%
Cadmium	0.000170	J	0.00500	mg/l	0.0026	mg/l	1:1		-0.000510	-0.288%	76.9%
Chromium	0.00263	J	0.0300	mg/l	0.0081	mg/l	1:1		0.00727	-0.992%	84.7%
Copper	0.0163	J	0.0300	mg/l	0.0058	mg/l	1:1		0.00388	-1.33%	86.8%
Nickel	0.00340	J	0.0300	mg/l	0.005	mg/l	1:1		-0.00318	-0.268%	78.9%
Zinc	0.0201		0.0200	mg/l	0.005	mg/l	1:1		0.00163	2.08%	80.4%
BG: Mercury Method: EPA 7470					Batch: 56701 Run Analyst: ADF DOA: 11/08/94 TOA: 1343 OK						

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications	
FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/10/94

Sample: 9410555-02 Client ID: Matrix: Elutriate Description: Elutriate-Dissolved
Sampled: 10/31/94 Received: 10/31/94 Page: 4
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
						Prep Analyst: ADF DOP: 11/07/94 TOP: 1700 OK					
Mercury	0.159	J	0.500	ug/l	0.2	ug/l	1:1		0.0320	1.90%	99.3%
BG: Cyanide by RFA	Method: EPA 335.3					Batch: 56559 Run Analyst: JEN DOA: 11/03/94 TOA: 1500 OK					
Cyanide, Total	0.000950	J	0.0100	mg/l	0.01	mg/l	1:1		0.000950	0.00%	91.2%
BG: RFA	Method: EPA 420.2					Batch: 56350 Run Analyst: JEN DOA: 11/01/94 TOA: 1400 OK					
Phenols, Total	0.690	J	10.0	ug/l	5	ug/l	1:1		0.690	0.00%	111%

Comments:

A dilution was required for arsenic, lead, antimony and selenium due to matrix interference. As a result, the detection limits are elevated.

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

GENERAL ENGINEERING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/10/94

Sample: 9410555-02 Client ID: Matrix: Elutriate Description: Elutriate-Dissolved
Sampled: 10/31/94 Received: 10/31/94 Page: 5
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Tom Hutto at (803) 556-8171.

Kendra Middleton

Analytical Report Specialist

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications

FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410460-01 Client ID: Matrix: SurfaceH2O Description: Background
Sampled: 10/25/94 Received: 10/25/94 Page: 1
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: GC/MS Extractables Method: EPA 8270					Batch: 56228 Run Analyst: TDE DOA: 11/01/94 TOA: 0018 OK						
					Prep Analyst: GWL DOP: 10/28/94 TOP: 1300 OK						
2,4,6-Trichlorophenol	0.00	U	10.0	ug/l	2.3	ug/l	1:1		0.00		
2,4-Dichlorophenol	0.00	U	10.0	ug/l	1.12	ug/l	1:1		0.00		
2,4-Dimethylphenol	0.00	U	10.0	ug/l	3.6	ug/l	1:1		0.00		
2,4-Dinitrophenol	0.00	U	45.0	ug/l	8.88	ug/l	1:1		0.00		
2-Chlorophenol	0.00	U	10.0	ug/l	1.06	ug/l	1:1		0.00	0.00%	83.7%
2-Nitrophenol	0.00	U	10.0	ug/l	1.14	ug/l	1:1		0.00		
2-methyl-4,6-dinitrophenol	0.00	U	50.0	ug/l	1.78	ug/l	1:1		0.00		
4-Nitrophenol	0.00	U	20.0	ug/l	2.97	ug/l	1:1		0.00		
4-chloro-3-methyl phenol	0.00	U	10.0	ug/l	1.32	ug/l	1:1		0.00	0.00%	93.2%
Pentachlorophenol	0.00	U	10.0	ug/l	1.6	ug/l	1:1		0.00	0.00%	111%
Phenol	0.00	U	10.0	ug/l	0.46	ug/l	1:1		0.00	0.00%	51.0%
BG: GC/MS Extractables Method: EPA 8270					Batch: 56228 Run Analyst: TDE DOA: 11/01/94 TOA: 0018 OK						
					Prep Analyst: GWL DOP: 10/28/94 TOP: 1300 OK						
1,2,4-Trichlorobenzene	0.00	U	10.0	ug/l	1.57	ug/l	1:1		0.00	0.00%	77.0%
1,2-Diphenylhydrazine	0.00	U	10.0	ug/l	1.13	ug/l	1:1		0.00		
2,4-Dinitrotoluene	0.00	U	10.0	ug/l	2.02	ug/l	1:1		0.00	0.00%	81.2%
2,6-Dinitrotoluene	0.00	U	10.0	ug/l	1.59	ug/l	1:1		0.00		
2-Chloronaphthalene	0.00	U	10.0	ug/l	1.6	ug/l	1:1		0.00		
3,3'-Dichlorobenzidine	0.00	U	50.0	ug/l	2.51	ug/l	1:1		0.00		
4,4'-DDD	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4,4'-DDE	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4,4'-DDT	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
4-Bromophenyl phenyl ether	0.00	U	10.0	ug/l	0.72	ug/l	1:1		0.00		
4-Chlorophenyl phenyl ether	0.00	U	10.0	ug/l	1.98	ug/l	1:1		0.00		
Acenaphthene	0.00	U	10.0	ug/l	1.57	ug/l	1:1		0.00	0.00%	84.6%
Acenaphthylene	0.00	U	10.0	ug/l	1.68	ug/l	1:1		0.00		
Aldrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Anthracene	0.00	U	10.0	ug/l	1.71	ug/l	1:1		0.00		
Benzidine	0.00	U	50.0	ug/l	16.2	ug/l	1:1		0.00		
Benzo(a)anthracene	0.00	U	10.0	ug/l	2.15	ug/l	1:1		0.00		
Benzo(a)pyrene	0.00	U	10.0	ug/l	1.42	ug/l	1:1		0.00		
Benzo(b)fluoranthene	0.00	U	10.0	ug/l	1.4	ug/l	1:1		0.00		
Benzo(ghi)perylene	0.00	U	10.0	ug/l	1.27	ug/l	1:1		0.00		
Benzo(k)fluoranthene	0.00	U	10.0	ug/l	0.87	ug/l	1:1		0.00		
Butyl benzyl phthalate	0.00	U	10.0	ug/l	1.84	ug/l	1:1		0.00		

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications

FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410460-01 Client ID: Matrix: SurfaceH2O Description: Background
Sampled: 10/25/94 Received: 10/25/94 Page: 2

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
Chlordane	0.00	U	10.0	ug/l	0.01	ug/l	1:1		0.00		
Chrysene	0.00	U	10.0	ug/l	0.95	ug/l	1:1		0.00		
Di-n-butyl phthalate	0.00	U	10.0	ug/l	1.09	ug/l	1:1		0.00		
Di-n-octyl phthalate	0.00	U	10.0	ug/l	2.24	ug/l	1:1		0.00		
Dibenzo(a,h)anthracene	0.00	U	10.0	ug/l	1.19	ug/l	1:1		0.00		
Dieldrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Diethyl phthalate	0.00	U	10.0	ug/l	1.42	ug/l	1:1		0.00		
Dimethyl phthalate	0.00	U	10.0	ug/l	1.65	ug/l	1:1		0.00		
Endosulfan I	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endosulfan II	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endosulfan sulfate	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endrin	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Endrin aldehyde	95.0		10.0	ug/l	2	ug/l	1:1		0.00		
Fluoranthene	0.00	U	10.0	ug/l	1.02	ug/l	1:1		0.00		
Fluorene	0.00	U	10.0	ug/l	1.91	ug/l	1:1		0.00		
Heptachlor	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Heptachlor epoxide	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
Hexachlorobenzene	0.00	U	10.0	ug/l	1.33	ug/l	1:1		0.00		
Hexachlorobutadiene	0.00	U	10.0	ug/l	2.04	ug/l	1:1		0.00		
Hexachlorocyclopentadiene	0.00	U	10.0	ug/l	1.69	ug/l	1:1		0.00		
Hexachloroethane	0.00	U	10.0	ug/l	1.68	ug/l	1:1		0.00		
Indeno(1,2,3-c,d)pyrene	0.00	U	10.0	ug/l	0.89	ug/l	1:1		0.00		
Isophorone	0.00	U	10.0	ug/l	1.37	ug/l	1:1		0.00		
N-Nitrosodimethylamine	0.00	U	10.0	ug/l	0.77	ug/l	1:1		0.00		
N-Nitrosodiphenylamine	0.00	U	10.0	ug/l	1.32	ug/l	1:1		0.00		
N-Nitrosodipropylamine	0.00	U	10.0	ug/l	1.41	ug/l	1:1		0.00	0.00%	72.8%
Naphthalene	0.00	U	10.0	ug/l	1.78	ug/l	1:1		0.00		
Nitrobenzene	0.00	U	10.0	ug/l	1.61	ug/l	1:1		0.00		
PCB-1016	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1221	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1232	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1242	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1248	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1254	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
PCB-1260	0.00	U	150.	ug/l	0.15	ug/l	1:1		0.00		
Phenanthrene	0.00	U	10.0	ug/l	1.72	ug/l	1:1		0.00		
Pyrene	0.00	U	10.0	ug/l	1.17	ug/l	1:1		0.00	0.00%	90.6%
Toxaphene	0.00	U	10.0	ug/l	0.01	ug/l	1:1		0.00		
alpha-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		

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FL	E87156/87294
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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410460-01 Client ID: Matrix: SurfaceH2O Description: Background
Sampled: 10/25/94 Received: 10/25/94 Page: 3
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
beta-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
bis(2-Chloroethoxy)methane	0.00	U	10.0	ug/l	1.4	ug/l	1:1		0.00		
bis(2-Chloroethyl) ether	0.00	U	10.0	ug/l	1.39	ug/l	1:1		0.00		
bis(2-Chloroisopropyl)ether	0.00	U	10.0	ug/l	1.91	ug/l	1:1		0.00		
bis(2-Ethylhexyl)phthalate	0.00	U	10.0	ug/l	1.61	ug/l	1:1		0.00		
delta-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
gamma-BHC	0.00	U	10.0	ug/l	2	ug/l	1:1		0.00		
BG: Graphite Furnace Method: EPA 7060						Batch: 56096 Run Analyst: RMJ DOA: 10/28/94 TOA: 1228 OK					
						Prep Analyst: BBJ DOP: 10/26/94 TOP: 1900 OK					
Arsenic	2.30	J	5.00	ug/l	2	ug/l	1:1		0.0600	0.00%	81.9%
BG: Graphite Furnace Method: EPA 7421						Batch: 56096 Run Analyst: RMJ DOA: 10/28/94 TOA: 1228 OK					
						Prep Analyst: BBJ DOP: 10/26/94 TOP: 1900 OK					
Lead	0.310	J	5.00	ug/l	2	ug/l	1:1		0.790	-9.09%	90.3%
BG: Graphite Furnace Method: EPA 7041						Batch: 56096 Run Analyst: RMJ DOA: 10/28/94 TOA: 1228 OK					
						Prep Analyst: BBJ DOP: 10/26/94 TOP: 1900 OK					
Antimony	-3.11	U	5.00	ug/l	3	ug/l	1:1		-0.130	-9.49%	90.8%
BG: Graphite Furnace Method: EPA 7740						Batch: 56096 Run Analyst: RMJ DOA: 10/28/94 TOA: 1228 OK					
						Prep Analyst: BBJ DOP: 10/26/94 TOP: 1900 OK					
Selenium	-0.670	U	5.00	ug/l	2	ug/l	1:1		0.580	3.34%	76.6%
BG: Graphite Furnace Method: EPA 7841						Batch: 56096 Run Analyst: RMJ DOA: 10/28/94 TOA: 1228 OK					
						Prep Analyst: BBJ DOP: 10/26/94 TOP: 1900 OK					
Thallium	-0.260	U	5.00	ug/l	2	ug/l	1:1		-0.200	-1.28%	74.4%
BG: ICP Method: EPA 6010						Batch: 56097 Run Analyst: JSS DOA: 10/27/94 TOA: 1106 OK					
						Prep Analyst: BBJ DOP: 10/26/94 TOP: 2000 OK					
Silver	-0.00840	U	0.0300	mg/l	0.005	mg/l	1:1		-0.00175	2.44%	92.5%
Beryllium	0.000100	J	0.0100	mg/l	0.0002	mg/l	1:1		0.0000300	0.991%	94.8%
Cadmium	-0.000800	U	0.00500	mg/l	0.0026	mg/l	1:1		-0.00114	1.41%	88.5%
Chromium	-0.00180	U	0.0300	mg/l	0.0081	mg/l	1:1		0.00698	2.05%	80.3%
Copper	0.00310	J	0.0300	mg/l	0.0058	mg/l	1:1		0.00278	1.39%	91.8%
Nickel	0.00530	J	0.0300	mg/l	0.005	mg/l	1:1		0.00615	0.109%	91.1%
Zinc	-0.00740	U	0.0200	mg/l	0.005	mg/l	1:1		0.00133	2.01%	86.9%
BG: Mercury Method: EPA 7470						Batch: 56301 Run Analyst: ADF DOA: 11/01/94 TOA: 1140 OK					

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410460-01 Client ID: Matrix: SurfaceH2O Description: Background
Sampled: 10/25/94 Received: 10/25/94 Page: 4
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
						Prep Analyst: ADF	DOP: 10/31/94	TOP: 1400	OK		
Mercury	-0.0600	U	2.00	ug/l	2	ug/l	1:1		0.303	0.00%	94.8%
BG: Cyanide by RFA	Method: EPA 335.3				Batch: 56487	Run Analyst: JEN	DOA: 11/02/94	TOA: 1500	OK		
Cyanide, Total	0.000470	J	0.0100	mg/l	0.01	mg/l	1:1		0.000470	0.00%	93.0%
BG: RFA	Method: EPA 420.2				Batch: 56349	Run Analyst: JEN	DOA: 11/01/94	TOA: 1400	OK		
Phenols, Total	0.690	J	10.0	ug/l	5	ug/l	1:1		0.690	0.00%	78.8%
BG: Solids Analyses	Method: EPA 160.2				Batch: 56968	Run Analyst: MAS	DOA: 11/11/94	TOA: 0930	NOT OK		
Solids, Total Suspended	9.00		1.00	mg/l	1	mg/l	1:1		0.00	0.00%	N/C

Comments:
This sample was analyzed beyond the recommended holding time for Solids, Total Suspended.

Report Heading Definitions

- Result - Result
- Qual - Qualifier
- RL - Reporting Limit
- Units - Reporting Limit Units
- MDL - Method Detection Limit
- Units - Method Detection Limit Units
- DF - Dilution Factor
- Surr. % - Percent Surrogate Recovery
- Blank - Blank Result
- RPD - Relative Percent Difference
- %Rec - Average Percent Spike Recovery

Qualifier Definitions

- U - value <= 0
- J - value <= RL
- JB - hit in blanks

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Contact: Mr. J. Guerry Taylor

Report Date: 11/11/94

Sample: 9410460-01 Client ID: Matrix: SurfaceH2O Description: Background
Sampled: 10/25/94 Received: 10/25/94 Page: 5
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

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Kendra Middleton

Analytical Report Specialist

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/22/94

Sample: 9411385-01 Client ID: Matrix: Soil Description: 9410460-03-R TCLP 1
Sampled: 10/25/94 Received: 11/18/94 Page: 1
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: Other Organic Tests Method: EPA 3550							Batch: 57537 Run Analyst: TMK DOA: 11/21/94 TOA: 1700 OK				
Evaporative Loss @ 105 C	63.0		1.00	wt%	1	wt%	1:1		0.00	0.00%	N/C
BG: Waste Characterizations Method: SM 16th ed. 213E							Batch: 57538 Run Analyst: TSM DOA: 11/21/94 TOA: 1410 OK				
Specific Gravity	1.28		0.000100	none	0.0001	none	1:1		N/C	-1.57%	N/

Data reported in mass/mass units is reported as 'dry weight'.

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

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Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/22/94

Sample: 9411385-01 Client ID: Matrix: Soil Description: 9410460-03-R TCLP 1
Sampled: 10/25/94 Received: 11/18/94 Page: 2
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/22/94

Sample: 9411385-02 Client ID: Matrix: Soil Description: 9410460-04-R TCLP 2
Sampled: 10/25/94 Received: 11/18/94 Page: 1
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: Other Organic Tests Method: EPA 3550							Batch: 57537 Run Analyst: TMK DOA: 11/21/94 TOA: 1700 OK				
Evaporative Loss @ 105 C	63.0		1.00	wt%	1	wt%	1:1		0.00	0.00%	N/C
BG: Waste Characterizations Method: SM 16th ed. 213E							Batch: 57538 Run Analyst: TSM DOA: 11/21/94 TOA: 1410 OK				
Specific Gravity	1.31		0.000100	none	0.0001	none	1:1		N/C	-1.57%	N/C

Data reported in mass/mass units is reported as 'dry weight'.

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/22/94

Sample: 9411385-02 Client ID: Matrix: Soil Description: 9410460-04-R TCLP 2
Sampled: 10/25/94 Received: 11/18/94 Page: 2
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/05/94

Sample: 9410460-03 Client ID: Matrix: TCLP Description: TCLP 1
Sampled: 10/25/94 Received: 10/25/94 Page: 1
Project: JGTI00494 Manager: TDH

BG: GC/MS Extractables Method: EPA 8270 Batch: 56240 Run Analyst: HNM DOA: 11/01/94 TOA: 1543 OK
Prep Analyst: SHC DOP: 10/31/94 TOP: 1600 OK
TCLP Prep Analyst: JL DOT: 10/28/94 TOT: 1005 OK

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
Acenaphthene	0.0280		0.0100	mg/l	0.00157	mg/l	1:1		0.00	N/C	99.4%
Acenaphthylene	0.00	U	0.0100	mg/l	0.00168	mg/l	1:1		0.00	N/C	N/C
Anthracene	0.00221	J	0.0100	mg/l	0.00171	mg/l	1:1		0.00	N/C	N/C
Benzo(a)anthracene	0.00	U	0.0100	mg/l	0.00215	mg/l	1:1		0.00	N/C	N/C
Benzo(a)pyrene	0.00	U	0.0100	mg/l	0.00142	mg/l	1:1		0.00	N/C	N/C
Benzo(b)fluoranthene	0.00	U	0.0100	mg/l	0.0014	mg/l	1:1		0.00	N/C	N/C
Benzo(ghi)perylene	0.00	U	0.0100	mg/l	0.00127	mg/l	1:1		0.00	N/C	N/C
Benzo(k)fluoranthene	0.00	U	0.0100	mg/l	0.00087	mg/l	1:1		0.00	N/C	N/C
Chrysene	0.00	U	0.0100	mg/l	0.00095	mg/l	1:1		0.00	N/C	N/C
Dibenzo(a,h)anthracene	0.00	U	0.0100	mg/l	0.00119	mg/l	1:1		0.00	N/C	N/C
Fluoranthene	0.00235	J	0.0100	mg/l	0.00102	mg/l	1:1		0.00	N/C	N/C
Fluorene	0.00811	J	0.0100	mg/l	0.00191	mg/l	1:1		0.00	N/C	N/C
Indeno(1,2,3-c,d)pyrene	0.00	U	0.0100	mg/l	0.00089	mg/l	1:1		0.00	N/C	N/C
Naphthalene	0.00125	J	0.0100	mg/l	0.00178	mg/l	1:1		0.00	N/C	N/C
Phenanthrene	0.00700	J	0.0100	mg/l	0.00172	mg/l	1:1		0.00	N/C	N/C
Pyrene	0.00191	J	0.0100	mg/l	0.00117	mg/l	1:1		0.00	N/C	N/C

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

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Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/05/94

Sample: 9410460-03 Client ID: Matrix: TCLP Description: TCLP 1
Sampled: 10/25/94 Received: 10/25/94 Page: 2
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

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Kendra Middleton
Analytical Report Specialist

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/08/94

Sample: 9410460-04 Client ID: Matrix: TCLP Description: TCLP 2
Sampled: 10/25/94 Received: 10/25/94 Page: 1

Project: JGTI00494 Manager: TDH

BG: GC/MS Extractables Method: EPA 8270 Batch: 56571 Run Analyst: HNM DOA: 11/07/94 TOA: 1635 OK
Prep Analyst: KJB DOP: 11/03/94 TOP: 2200 OK
TCLP Prep Analyst: JL DOT: 10/28/94 TOT: 1005 OK

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
Acenaphthene	0.000830	J	0.0100	mg/l	0.00157	mg/l	1:1		0.00	-2.27%	89.4%
Acenaphthylene	0.00	U	0.0100	mg/l	0.00168	mg/l	1:1		0.00	0.00%	N/C
Anthracene	0.000480	J	0.0100	mg/l	0.00171	mg/l	1:1		0.00	1.98%	N/C
Benzo(a)anthracene	0.00	U	0.0100	mg/l	0.00215	mg/l	1:1		0.00	0.00%	N/C
Benzo(a)pyrene	0.00	U	0.0100	mg/l	0.00142	mg/l	1:1		0.00	0.00%	N/C
Benzo(b)fluoranthene	0.00	U	0.0100	mg/l	0.0014	mg/l	1:1		0.00	0.00%	N/C
Benzo(ghi)perylene	0.00	U	0.0100	mg/l	0.00127	mg/l	1:1		0.00	0.00%	N/C
Benzo(k)fluoranthene	0.00	U	0.0100	mg/l	0.00087	mg/l	1:1		0.00	0.00%	N/C
Chrysene	0.00	U	0.0100	mg/l	0.00095	mg/l	1:1		0.00	0.00%	N/C
Dibenzo(a,h)anthracene	0.00	U	0.0100	mg/l	0.00119	mg/l	1:1		0.00	0.00%	N/C
Fluoranthene	0.00	U	0.0100	mg/l	0.00102	mg/l	1:1		0.00	0.00%	N/C
Fluorene	0.00	U	0.0100	mg/l	0.00191	mg/l	1:1		0.00	0.00%	N/C
Indeno(1,2,3-c,d)pyrene	0.00	U	0.0100	mg/l	0.00089	mg/l	1:1		0.00	0.00%	N/C
Naphthalene	0.00	U	0.0100	mg/l	0.00178	mg/l	1:1		0.00	0.00%	N/C
Phenanthrene	0.00	U	0.0100	mg/l	0.00172	mg/l	1:1		0.00	0.00%	N/C
Pyrene	0.00	U	0.0100	mg/l	0.00117	mg/l	1:1		0.00	-3.16%	86.7%

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

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Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/08/94

Sample: 9410460-04 Client ID: Matrix: TCLP Description: TCLP 2
Sampled: 10/25/94 Received: 10/25/94 Page: 2

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Tom Hutto at (803) 556-8171.

Sandra Middleton

Analytical Report Specialist

GENERAL ENGINEERING LABORATORIES

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Laboratory Certifications	
FL	E87156/87294
NC	233
SC	10120
TN	02934
VA	00151
WI	99988779

CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/14/94

Sample: 9410460-05 Client ID: Matrix: Sediment Description: TC PAH 1
Sampled: 10/25/94 Received: 10/25/94 Page: 1
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: Other Organic Tests Method: EPA 3550					Batch: 56432 Run Analyst: GWL DOA: 11/02/94 TOA: 1500 OK						
Evaporative Loss @ 105 C	62.0		1.00	wt%	1	wt%	1:1		0.00	-12.9%	N/C
BG: GC/MS Extractables Method: EPA 8270					Batch: 56430 Run Analyst: TNF DOA: 11/04/94 TOA: 1517 OK						
					Prep Analyst: GWL DOP: 11/02/94 TOP: 1700 OK						
Acenaphthene	3830		866.	ug/kg	270	ug/kg	1:1		0.00	0.00%	62.1%
Acenaphthylene	0.00	U	866.	ug/kg	307	ug/kg	1:1		0.00	0.00%	N/C
Anthracene	3190		866.	ug/kg	294	ug/kg	1:1		0.00	0.00%	N/C
Benzo(a)anthracene	0.00	U	866.	ug/kg	455	ug/kg	1:1		0.00	0.00%	N/C
Benzo(a)pyrene	0.00	U	866.	ug/kg	433	ug/kg	1:1		0.00	0.00%	N/C
Benzo(b)fluoranthene	3930		866.	ug/kg	513	ug/kg	1:1		0.00	0.00%	N/C
Benzo(ghi)perylene	0.00	U	866.	ug/kg	724	ug/kg	1:1		0.00	0.00%	N/C
Benzo(k)fluoranthene	0.00	U	866.	ug/kg	372	ug/kg	1:1		0.00	0.00%	N/C
Chrysene	2040		866.	ug/kg	363	ug/kg	1:1		0.00	0.00%	N/C
Dibenzo(a,h)anthracene	0.00	U	866.	ug/kg	582	ug/kg	1:1		0.00	0.00%	N/C
Fluoranthene	7110		866.	ug/kg	394	ug/kg	1:1		0.00	0.00%	N/C
Fluorene	0.00	U	866.	ug/kg	341	ug/kg	1:1		0.00	0.00%	N/C
Indeno(1,2,3-c,d)pyrene	0.00	U	866.	ug/kg	481	ug/kg	1:1		0.00	0.00%	N/C
Naphthalene	828.	J	866.	ug/kg	319	ug/kg	1:1		0.00	0.00%	N/C
Phenanthrene	6940		866.	ug/kg	295	ug/kg	1:1		0.00	0.00%	N/C
Pyrene	0.00	U	866.	ug/kg	431	ug/kg	1:1		0.00	0.00%	78.5%

Data reported in mass/mass units is reported as 'dry weight'.

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P,E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/14/94

Sample: 9410460-05 Client ID: Matrix: Sediment Description: TC PAH 1
Sampled: 10/25/94 Received: 10/25/94 Page: 2
Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec

Report Heading Definitions

Result - Result
Qual - Qualifier
RL - Reporting Limit
Units - Reporting Limit Units
MDL - Method Detection Limit
Units - Method Detection Limit Units
DF - Dilution Factor
Surr. % - Percent Surrogate Recovery
Blank - Blank Result
RPD - Relative Percent Difference
%Rec - Average Percent Spike Recovery

Qualifier Definitions

U - value <= 0
J - value <= RL
JB - hit in blanks

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Tom Hutto at (803) 556-8171.

Kendra Middleton

Analytical Report Specialist

GENERAL ENGINEERING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: Jon Guerry Taylor, P.E., Inc.
Post Office Box 1082
Mt. Pleasant, SC 29465
Contact: Mr. J. Guerry Taylor

Report Date: 11/14/94

Sample: 9410460-06 Client ID: Matrix: Sediment Description: TC PAH 2
Sampled: 10/25/94 Received: 10/25/94 Page: 1

Project: JGTI00494 Manager: TDH

Parameter	Result	Qual	RL	Units	MDL	Units	DF	Surr. %	Blank	RPD	%Rec
BG: Other Organic Tests Method: EPA 3550					Batch: 56432 Run Analyst: GWL DOA: 11/02/94 TOA: 1500 OK						
Evaporative Loss @ 105 C	61.0		1.00	wt%	1	wt%	1:1		0.00	-12.9%	N/C
BG: GC/MS Extractables Method: EPA 8270					Batch: 56430 Run Analyst: TNF DOA: 11/04/94 TOA: 1550 OK						
					Prep Analyst: GWL DOP: 11/02/94 TOP: 1700 OK						
Acenaphthene	0.00	U	849.	ug/kg	265	ug/kg	1:1		0.00	0.00%	62.1%
Acenaphthylene	0.00	U	849.	ug/kg	301	ug/kg	1:1		0.00	0.00%	N/C
Anthracene	0.00	U	849.	ug/kg	289	ug/kg	1:1		0.00	0.00%	N/C
Benzo(a)anthracene	0.00	U	849.	ug/kg	447	ug/kg	1:1		0.00	0.00%	N/C
Benzo(a)pyrene	0.00	U	849.	ug/kg	425	ug/kg	1:1		0.00	0.00%	N/C
Benzo(b)fluoranthene	0.00	U	849.	ug/kg	504	ug/kg	1:1		0.00	0.00%	N/C
Benzo(ghi)perylene	0.00	U	849.	ug/kg	710	ug/kg	1:1		0.00	0.00%	N/C
Benzo(k)fluoranthene	1470		849.	ug/kg	365	ug/kg	1:1		0.00	0.00%	N/C
Chrysene	0.00	U	849.	ug/kg	356	ug/kg	1:1		0.00	0.00%	N/C
Dibenzo(a,h)anthracene	0.00	U	849.	ug/kg	571	ug/kg	1:1		0.00	0.00%	N/C
Fluoranthene	1800		849.	ug/kg	386	ug/kg	1:1		0.00	0.00%	N/C
Fluorene	0.00	U	849.	ug/kg	335	ug/kg	1:1		0.00	0.00%	N/C
Indeno(1,2,3-c,d)pyrene	0.00	U	849.	ug/kg	472	ug/kg	1:1		0.00	0.00%	N/C
Naphthalene	0.00	U	849.	ug/kg	313	ug/kg	1:1		0.00	0.00%	N/C
Phenanthrene	0.00	U	849.	ug/kg	290	ug/kg	1:1		0.00	0.00%	N/C
Pyrene	0.00	U	849.	ug/kg	423	ug/kg	1:1		0.00	0.00%	78.5%

Data reported in mass/mass units is reported as 'dry weight'.

APPENDIX C

ERM VALUES

Table 3. ERM guideline values for trace metals (ppm, dry wt.)	
Guidelines	
Chemical	**ERM**
Arsenic	70
Cadmium	9.6
Chromium	370
Copper	270
Lead	218
Mercury	0.71
Nickel	51.6
Silver	3.7
Zinc	410

Table 4. ERM guideline values for organic compounds (ppb, dry wt.)	
Guidelines	
Chemical	**ERM**
Acenaphthene	500
Acenaphthylene	640
Anthracene	1100
Fluorine	540
2-methyl naphthalene	670
Naphthalene	2100
Phenanthrene	1500
Low Mol. Wt. PAH	3160
Benz(a)anthracene	1600
Benzo(a)pyrene	1600
Chrysene	2800
Dibenzo(a.h.)anthracene	260
Fluoranthene	5100
Pyrene	2600
High Mol.Wt. PAH	9600
Total PAH	44792
p.p-DDE	27
Total DDT	46.1
Total PCBs	180

APPENDIX D

BIOREMEDIATION STUDY - EXECUTIVE SUMMARY

EVALUATION OF TREATMENT ALTERNATIVES FOR PAH-CONTAINING DREDGED SEDIMENTS

for

Charleston Maritime Center Project
Jon Guerry Taylor, P.E., Inc.

Executive Summary

1.0 Background

Approximately 105,000 cubic yards of sediments will be dredged from the Charleston Harbor at the Charleston Maritime Center location to construct a new marina. The sediments will be hydraulically dredged and deposited on an approximately 20 acre spoil site located on the North Drum Island Dredged Material Area.

Laboratory analyses of sediment samples from the Charleston Maritime Center site indicate that the sediments contain 18.5 milligrams per kilogram (mg/kg) total polynuclear aromatic hydrocarbons (PAHs) based on the Environmental Protection Agency (EPA) list of 16 compounds. However, the results of the sediment elutriate testing indicate that the discharge of sediment-free water from the dredged material basin will not contain detectable levels of PAHs.

Because of future use requirements for the dredged material area, all remediation and dewatering of the dredged sediments must be completed within 18 months of the dredging phase of the project.

2.0 Purpose and Scope

General Engineering Laboratories, Inc. (GEL) was contracted by Jon Guerry Taylor, P.E., Inc. (JGT) to research and evaluate current practices and available technologies which could be used to remediate and/or dispose of the dredged PAH-containing sediments from the Charleston Maritime Center in an environmentally sensitive manner. The focus of GEL's research and evaluation was the pretreatment and treatment of the dredged material and the disposal of the sediment. Research and evaluation of the removal and transport components of the dredging project were considered to be outside of the project's scope.

3.0 Approach

To research applicable sediment remediation and/or management technologies for the Charleston Maritime Center project, GEL reviewed available information from the following sources:

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P O Box 30712 • Charleston, SC 29417 • 2040 Savage Road • 29414
(803) 556-8171 • Fax (803) 766-1178

- Environmental databases on GEL's computer information network.
- Environmental Protection Agency (EPA) and Army Corps of Engineers (ACE) documents.
- Phone interviews with experienced government agency personnel who are knowledgeable regarding sediment dredging and treatment projects.
- Pre-proposals from remediation companies.

This information was then evaluated to meet the following objectives:

- To identify sediment remediation and/or management practices and technologies which merit consideration for full-scale application for the Charleston Maritime Center project.
- To make recommendations on an approach to evaluate the technical and economic feasibility of the promising sediment remediation and/or management practices and technologies.

4.0 Key Findings

4.1 Computer Assisted Search of Environmental Databases

GEL's search of available EPA databases identified eight project abstracts which potentially applied to the Charleston Maritime Center project. The abstracts were identified based on a focused computer-assisted search which keyed inclusively on "remediate," "dredge," "material or spoil," and "hydrocarbon."

The eight abstracts are summarized in Table 1. Only one of the abstracts involved a project with PAH-containing sediments. In this abstract, the disposal of approximately 8,000 cubic yards of PAH-containing sediments in an upland sediment treatment facility was discussed. The emphasis for this project was containment and exposure considerations rather than remediation of the PAH-containing sediments. The other seven abstracts covered projects involving sediments containing high levels of polychlorinated biphenyls (PCBs) and dioxins.

4.2 Review of EPA and ACE Documents

Based on a review of the EPA's *Superfund Innovative Technology Evaluation (SITE) Program: Technology Profiles, 6th Edition, November 1993*, several technologies have been demonstrated to be technically feasible for the remediation of PAH-containing sediments, including slurry-phase bioremediation, thermal desorption, gas-phase chemical reduction, solvent extraction, and soil and sediment washing. The pertinent details of these

projects are summarized in Table 2. Based on site-specific considerations, slurry phase bioremediation and sediment washing are the two technologies most applicable to the conditions encountered at the Charleston Maritime Center project.

Additionally, several emerging technologies have been identified under the SITE Program for the remediation of PAH-containing sediments. Details on the emerging technologies are also summarized in Table 2.

The ACE's *Review of Removal, Containment and Treatment Technologies for Remediation of Contaminated Sediment in the Great Lakes*, produced for the EPA's Assessment and Remediation of Contaminated Sediment (ARCS) Program, evaluated several pretreatment and treatment alternatives for the remediation of sediments. The various technologies were evaluated with regard to effectiveness, implementability, and cost.

According to the ACE's research, confined disposal facilities (CDFs), such as dredged material basins, are the best available sediment pretreatment technology, and biological (bioremediation) and immobilization (solidification/stabilization) based technologies are the best available sediment treatment technologies.

In particular, the ACE concluded that biological or immobilization treatment of sediments in a CDF represents the most technically and economically viable approach. Chemical, extraction, radiant energy, and thermal based technologies were determined not to be technically and/or economically feasible for sediment remediation.

4.3 Phone Interviews with Government Experts

Consistent with the database and literature search results, discussions with government experts indicated that experience with the remediation of dredged sediments is not extensive. According to these experts, the majority of experience has been obtained from experimental bench- or pilot-scale sediment remediation projects performed under the EPA's SITE Program or the EPA's ARCS Program.

With regard to PAH-containing sediments, they indicated that bioremediation is currently considered to be the most appropriate technology for full-scale application. The other technologies were reported to be either technically impracticable for full-scale application or prohibitively expensive ($200 to $400 per ton).

The government experts indicated that the upland disposal (such as at the Drum Island dredged material basin) of dredged sediments containing approximately 20 mg/kg of total PAHs would be considered an acceptable management approach. The relatively low PAH concentrations in the sediment were not believed to represent a significant toxicity risk for

aquatic fauna and flora as the PAH compounds would be tightly sorbed to the sediments. If exposure to PAH-containing sediments by terrestrial fauna was considered to be problematic, it was recommended that a cap consisting of clean cover over the sediments be considered.

4.4 Preproposals Solicited from Remediation Companies

To evaluate the technical expertise which would be available should the PAH-containing sediments at the site require remediation, seven remediation companies were solicited to submit preproposals for the project. The companies were generally recognized as experts in the area of bioremediation; however, the companies were encouraged to consider other innovative approaches to the project. Our only criteria was that the recommended technology(ies) in their preproposals must represent an environmentally sensitive approach.

Of the seven remediation companies which were solicited, five responded. A summary of the key aspects of their preproposals includes the following information and is summarized in Table 3:

- Estimated unit cost to remediate approximately 100,000 cubic yards of PAH-containing sediments.
- Projected project schedule.
- Projected percent degradation of PAH compounds over course of treatment.
- Recommendation for bench- or pilot-scale testing prior to initiating full-scale remediation and the estimated cost of this testing.
- Specific sediment handling and treatment approach.

5.0 Conclusions

5.1 Available Technologies for Remediation of Sediments

Based on information obtained from the database and literature searches and the interviews of government experts, it appears that nationwide experience with full-scale remediation of sediments containing PAHs is limited, particularly with sediments containing relatively low concentrations of PAHs such as those at the Charleston Maritime Center site. The majority of experience has been obtained from experimental bench- or pilot-scale sediment remediation projects performed under the EPA's SITE Program or the EPA's ARCS Program.

However, based on information provided in the preproposal submitted by Remediation Technologies, Inc. (RETEC), RETEC is currently conducting the full-scale bioremediation of PAH-containing sediments at the French Limited Superfund site in Texas. According to RETEC, the French Limited project is very comparable to the Charleston Maritime Center project.

5.2 Feasible Technologies for Charleston Maritime Center Project

Although several technologies could potentially be used to remediate PAH-containing sediments from the Charleston Maritime Center site, the preponderance of information indicates that bioremediation of the sediments is currently the most feasible technology considering the volume of material and the relatively low level of PAHs. This conclusion is supported by the fact that all five preproposals recommended slurry phase bioremediation of the sediments. Sediment washing followed by treatment of the dredge spoil effluent is considered to be significantly less applicable for the Charleston Maritime Center project due to the relatively low PAH concentrations in the sediments and environmental concerns associated with transferring the PAHs to the more mobile liquid phase.

5.3 Slurry Phase versus Solid Phase Bioremediation

Bioremediation of PAH-containing sediments can be performed in either the solid phase or slurry phase. Site-specific conditions indicate that slurry phase bioremediation would be more appropriate for the Charleston Maritime Center project for the following reasons:

- The transported sediments and dredge water will already be present in the slurry phase. To perform solid phase bioremediation, the sediments would require complete dewatering before initiating treatment. The project schedule does not allow sufficient time to accomplish sediment dewatering followed by solid phase bioremediation.

- Given the large volume of sediments to be treated in the Spoils Area, efficient materials handling systems would be required to bioremediate the sediments. Because sediments in the slurry phase can be readily pumped, amended, mixed, and agitated, bioremediation of the entire sediment volume would be possible. In the solid phase, bioremediation of all but the most surficial layer of dewatered sediments would be technically difficult and expensive to accomplish, even without time constraints.

5.4 Specific Considerations Regarding Bioremediation of PAH-Containing Sediments

Although the bioremediation of PAH-containing sediments has been successfully implemented at other sites, site-specific conditions could prevent the successful application of this technology to the sediments from the Charleston Maritime Center site. Potentially prohibitive factors include the presence of bacteristatic or bactericidal compounds which could be toxic to the bacteria if present in sufficiently high concentration (i.e. chlorides), selective degradation of non-PAH organic material in the sediments, and insufficient populations of indigenous bacteria capable of degrading the PAH compounds. Also, the bioremediation process could reduce the tendency for the PAH compounds to remain tightly sorbed to the sediments due to reductions in sediment organic content or from vigorous mixing and agitation.

Based on information contained in the preproposals solicited from the remediation companies, 95 percent reduction in 2 or 4 ring PAH compounds and 50 percent or greater reduction in the concentration of PAH compounds overall could be achievable within the project time frame if favorable site-specific conditions are present. Reduction of PAHs containing 5 or more rings is more difficult.

According to the various government experts and remediation companies, bench-scale and/or pilot-scale studies must be conducted before the technical and economic feasibility of full-scale bioremediation for the project can be determined.

6.0 Recommendations

6.1 Conduct Risk Assessment of PAH-Containing Sediments

It is recommended that additional document or database risk assessment of projected pre- and post-treatment sediment PAH concentrations be performed to provide some quantification of the environmental benefit of remediating the sediments. The resistance of 5 ring PAHs to biodegradation may limit the achievable environmental benefit of bioremediation.

6.2 Conduct Additional Research to Identify Comparable Projects

It is recommended that additional research be conducted to identify information on projects of comparable scope. Of particular interest would be information on the bioremediation project currently being conducted at the French Limited Superfund site by RETEC.

6.3 Perform Bench- and/or Pilot-Scale Studies

If bioremediation is considered to be environmentally beneficial and economically viable, bench-scale treatability studies and pilot-scale optimization studies should be performed prior to initiating full-scale bioremediation of the impacted sediments to ensure that site-specific conditions are conducive to meeting treatment targets.

Table 1
EPA Database Search
Abstracts of Applicable Sediment Remediation Projects

Project Title	Technology Description	Year Conducted	Evaluated Media	Processing Rate	Budget Cost Per Unit Treated	Comments
Aerated Static Pile Composting	Sediment Composting	1991	Dredged sediments	Batch	ND	Composting reduced sediments concentrations of acids, nitroglycerine, and nitrocellulose by 99.99 percent.
Commencement Bay Nearshore/Tideflats	Sediment Containment	ND	Pugent Sound sediments	ND	ND	Addresses sediment source control remediation including four sediment confinement alternatives for Pugent Sound.
Marathon Battery Site-ROD	Sediment Fixation	ND	Storage vault sediments	ND	ND	Remediation of sediment storage vault using fixation for metals impact.
Remediation of Lake Jaernsjoen	Disposal in Special Landfill	Future	Lake bottom sediments	ND	ND	Sediments the primary source for ongoing discharge of PCBs to the river.
Buckeye Reclamatin Landfill Site	NA	1991 ROD	Groudwater and leachate	ND	ND	Not applicable to Charleston Maritime Center Site
Bergman USA	Soil Washing	1991	Dredge spoil	ND	ND	Reduced PCB concentrations in the sediment by 91%
Washing Techology for the...	Soil Washing	ND	Lake Huron sediments	ND	67-$120 per Ton	Effectively removed PCBs, dioxins, and cyanides.
On-Site Bioremeidation Treatment...	Design and Construction for Treatment Area	ND	Tacoma, Wa. berth sediments	ND	ND	Emphasis of specifications is on treatment area foundation and liner details, containment water-control systems....

NA - Not Applicable
ND - No Data Available

Table 2
Superfund Innovative Technology Evaluation (SITE) Program: Technology Profiles, 6th Edition
Demonstrated and Emerging Technologies for Remediation of PAH Containing Sediments

Project Title	Technology Description	Year Evaluated	Evaluated Media	Processing Rate	Budget Cost Per Unit Treated	Comments
Demonstration						
Bergmann USA	Bergmann USA Soil and Sediment Washing Tec	1991	Soils and Sediment	350 tph	ND	23 commercial units have been applied at contaminated waste sites. Applications analysis report for demo...
Dehydro-Tech Corporation	Carver-Greenfield Process(R)	1990	Drilling Fluids	ND	$110-$210 per Ton	Cost Does not include disposal. Not feasible for Charleston Maritime Center Site
Ecova Corporation	Bioslurry Reactor	1991	KOO1 Waste	ND	ND	Carcinogenic PAHs were biodegraded by 93% to 500 mg/kg levels
Eli Eco Ligic International Inc.	Gas-Phase Chemical Reduction	1992	PCB Containing Waste Oil	ND	ND	99.99% DRE but not feasible for Charleston Marine Center site
Eli Eco Ligic International Inc.	Thermal Desorption Unit	1992	PCB Containing Soils	ND	ND	99.99% DRE but not feasible for Charleston Marine Center site
Remediation Technologies, Inc.	Liquid and Solids Biological Treatment	1987	Primarily Sludges	ND	ND	Practical for volumes greater than 10,000 cubic yards. Pojected for use in an area of the barge harbor at Utica...
Emerging						
ART International, Inc.	Low-Energy Solvent Extraction Process	1989	Bench-Scale Only	NA	ND	Not applicable to Charleston Maritime Center Site
Cognis, Inc.	Biological/Chemical Treatment	1992	Soils and Wastes	NA	ND	Not applicable to Charleston Maritime Center Site
Environmental Biotechnologies, Inc.	Microbial Composting Process	1993	Soils and sediment at MGP Sites	NA	ND	Not applicable to Charleston Maritime Center Site
High Voltage Envir. Applications, Inc.	High Energy Electron Beam Irradiation	1993	Hazardous Waste Sites	NA	ND	Not applicable to Charleston Maritime Center Site
Institute of Gas Technology	Fluid Extraction-Biological Degradation Process	1990	Superfund Site Soils	ND	ND	85-99% of detectable PAHs, including 2- to 6-ring compounds. Final report due late 1993
Vortc Corporation	Oxidation and Vitrification Process	1991	Industrial Waste	Over 16 tph	ND	Used to produce waste that will pass TCLP requirements
Warren Spring Laboratory	Physical and Chemical Treatment	1991	Soils	60 tph	ND	Pilot scheduled for December 1993.
Western Product Re overy Group, Inc.	CCBA Physical and Chemical Treatment	1991	Soils	10 tph	ND	Not applicable to Charleston Maritime Center Site

NA - Not Applicable
ND - No Data Available
tph - Tons Per Hour
DRE - Destruction and Removal Efficiency